ISSUES ARISING IN TAX AND BENEFIT MODELLING: THE CASE OF FAMILY CREDIT

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Abstract: Family Credit, and its successor the WFTC, have been central to the British welfare reform debate in recent years. This debate is informed by tax-benefit modelling, yet accurate modelling of Family Credit is fraught with potential problems. The main model input data are found to under-sample family credit recipients considerably, but those who it does sample seem representative of the family credit recipient population. Substantial mismatch is found between those reporting family credit receipt and those modelled as entitled. We show that regression techniques can be used to adjust model results for the fact of non take-up, but that data constraints leave no obvious way to deal with the equally significant problem of families who receive benefit but are not modelled as entitled. The difficulties posed by the input data's under-sampling and by the significant number of claimants without modelled entitlement lead us finally to consider the use (and the limitations) of calibrating results.

[1] Thanks are due to Mike Brewer and Andrew Dilnot for comments. The usual disclaimers apply.

Preface

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1. Introduction

There is good reason to be confident in using models to calculate the effects of reforming many components of the tax and benefit system. For example, a program like TAXBEN almost certainly gives a good estimate of the revenue effects of changing the main rates of income tax and National Insurance. The large proportion of individuals paying these taxes means that the FRS or FES input data contains a sufficient number of taxpayers to make it very unlikely that random variation in the sample will distort the results to any significant extent. Further, investigation of the FES in the dimensions that affect the calculation of taxes like National Insurance – principally earnings – have indicated that it is fairly reliable.[2]

But there are other areas of the tax and benefit system which policy-makers might be interested in, where there might be more reason to doubt the applicability of modelled results. More difficult issues arise in modelling such components of the system than do so in calculating the effects of the main taxes on income. In this case study we focus on the case of FC. Recently, this benefit has been central to social security policy – the government has made the system more generous and replaced cash payment with a new tax credit system. The benefit has also attracts a good deal of academic attention amongst those studying labour supply. Only a relatively small fraction of households receive this benefit, meaning that problems of random variation are more likely to be pronounced. Further, payment depends on a number of variables – number and age of children, wage, hours worked – leaving much scope for misrepresentation in the data to distort results. Finally, there are significant gaps between the modelled workings of the system and its effects in practice. These arise both from the failure of many individuals to claim the benefit to which they are entitled, and due to the gap between the point of time when circumstances were assessed for FC and the point at which 'snapshot' of income was recorded in the model's input data.

There are thus a number of reasons why the results that come out of a tax and benefit model will differ from known administrative totals, and here we analyses the cause, scale and possible remedies for these. We will look separately at issues relating to the input data used by tax and benefit models and their calculated output. First, in Section 2, we assess how representative the input data for our tax and benefit model is in the relevant dimensions. The data that we use, chiefly the Family Resources Survey (FRS) turns out to be highly representative of FC recipients in many dimensions, but the total number of

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[2] See - Johnson and McCrae, 1998 in *How reliable is the Family Expenditure Survey?* IFS report series. The authors contrast earnings data from the FES with the New Earnings Survey.

the group is significantly under-represented. We look to the FRS grossing scheme that is supplied by DSS as a possible explanation.

In Section 3, we turn to consider differences between our model's calculation of entitlement, and the official records of FC payments. Abstracting from any problem in the model's input data, there are two separate groups of families that cause divergence between these. First, the group of people that are modelled as entitled to FC but who do not report receipt of the benefit in the data. The most important reason why many of those with entitlement lack receipt is probably non-takeup of benefit. We consider the possibility of using the results of statistical analysis to adjust tax and benefit model results for this imperfect take up. Secondly, the group we see as receiving FC in the data even though we model them as being without any entitlement. The possibility of receiving FC for six months after the means test is the major explanation for this disparity between modelled results and those in the data. We find no satisfactory way of adjusting results in the light of this group, so we finally consider different possibilities for calibrating results to known administrative totals as a means of making the output of tax and benefit models more applicable to policy problems.

Section 4 concludes.

2. Model input data

A tax and benefit model needs to be run on a sample of households that is representative of the national population if its output is to form the basis of estimates of the cost, revenue and distributional effects of particular elements of the fiscal system. There are many dimensions in which we could assess how representative the data is, but because we are concerned with the accurate modelling of FC, we will focus on those that are likely to affect this. Perhaps the most crucial dimension is the level of reported receipt of FC in the data.[3] If the FRS contains, for example, a disproportionately high number of those who receive FC, or if it contains people who receive it at atypically high, then, all else being equal, we would expect that TAXBEN would overestimate the cost of FC. But we also want to make sure that the sample of families receiving FC in the input data is representative of the population more generally. Otherwise, we can not expect to calculate accurately the distributional effects of the benefit on different types of families – we may, for example, show it as being relatively more beneficial to lone parents, or those with large families than turns out to be the case.

We begin by looking at the numbers receiving FC in the data, and the distribution of their recorded receipt. We concentrate on analysing data from the 1996/97 FRS, but we have also looked at data from Family Expenditure Survey (FES) for 1994/95, 1995/96 and 1996/97 as well as examining the FRS for 1994/95 and 1995/96. We will refer to these data in the main text where they differ in an interesting way from the 1996/97 FRS, and a full set of results for comparison is available in Appendix 1. We assess the accuracy of the data by comparison with the official statistics recorded in the 'Family Credit Statistical Enquiry' for the autumn of the financial year that we are looking at. Of special interest, is the representativeness of the data with respect to the two main groups that receive FC – couples with children and lone parents. We will look at lone parents and couples separately for much of the analysis. All results from the FRS have been 'grossed up' using the standard scheme, unless we specifically state that they have not.

In examining receipt of FC in the FRS we have fairly substantial sample sizes. For example, there are 638 families on the benefit in 1996/97. But when we make comparisons with the FES sample sizes become much smaller, in the 1996/97 FES, there are 193 families in receipt of FC. To an extent in both surveys, but very much more especially in the FES, sample size can become problematic when we turn to consider small sub-samples of FC recipients.

2.1 How representative is the data?

2.1.1 Numbers on Family Credit

Both the FRS and the FES consistently under-represent the number of families in receipt of FC. In 1996/7 for example, the FRS suggested that there were 531,000 recipients of benefit, whereas in November 1996 (FC Statistical enquiry) official figures put the total

[3] Families in the FRS are asked which benefits they receive and how much they receive. Their answer is their "recorded receipt". Receipt is checked against a benefit book., where this is available.

number who were actually claiming the benefit at 725,000. The FRS figure is 73% of the recorded total, suggesting under-representation of recipients by some 27%.

Table 2.1 shows the numbers of recipients suggested by both the surveys in each of the financial years from 1994/95 to 1996/97 as a proportion of the number of recipients recorded in the administrative data in the autumn of that financial year. There is consistent under-representation. This result is consistent with the study of the reliability of income data in the FES undertaken by Johnson and McCrae (1998). They found under-representation of FC recipients in each of the first three years of FES data after the introduction of the benefit in 1988.

Table 2.1 – under-representation of FC recipients in the FRS and FES

Financial Year	FRS – number of recipients as proportion of known total	FES - number of recipients as proportion of known total
1994/95	72%	86%
1995/96	78%	71%
1997/98	73%	85%

Abstracting from all other problems, we might expect that this significant degree of under-representation in the model input data would lead TAXBEN to underestimate the number of families with entitlement. If, for whatever reason, the types of people who benefit from FC were less likely to be represented in the FRS than others, then we would expect the model to under-estimate the level of entitlement.

The degree of under-representation is fairly similar across lone parents and couples. Table 2.2 breaks down the analysis of contained in Table 2.1 by family type, for each year of the FRS data. Although there is some variation in the relative under-representation of the two groups, it is clear that the FRS seems consistently to suggest that there are around 25% fewer recipients of either type than is seen in the administrative data.

Table 2.2 Under-representation of couple and lone parent FC recipients in the FRS

Financial Year	Lone parents – number of recipients as proportion of known total	Couples - number of recipients as proportion of known total
1994/95	72%	71%
1995/96	83%	74%
1996/97	69%	77%

2.1.2 Distribution of levels of Family Credit receipt

The average level of receipt of FC in the 1996/7 FRS is £55.40. The administrative data suggests that the FRS is highly accurate here: in November 1996 the actual average level was £56.92. A similar level of accuracy is found for the 1995/6 FRS, where the average receipt recorded is £50.90, whereas the administrative data for puts the figure at £52.29.

But how far is this accurate average level of receipt the product of the FRS's sample of recipients containing the correct distribution of receipt? The table below shows the fraction of recipients recorded as being on different levels of FC in both the administrative data for November 1996 and then for the FRS.

Table 2.3 The distribution of receipt in the 1996/7 FRS compared to that in administrative data

Amount of FC (£s per week)	Fraction of total in the FRS	Fraction of total in official figures
<£30	18%	18%
£30 - £60	38%	38%
>£60	44%	44%
Total	100% (total number - 532,000)	100% (total number – 725,000)

The high degree of accuracy of representation is clear, but it is possible that this is simply the product of chance. The tables in Appendix 1 suggest that the precise replication of the distribution of receipt is not replicated in other years, suggesting that this result in 1996/7 was in some part down to chance. In 1995/96 the FRS relatively over-samples FC recipients on the lowest levels of receipt, and in 1994/5 those in the middle band are relatively slightly over-represented by comparison with those in the top group. Nonetheless, some random variation is to be expected, and the overall pattern is very encouraging – the FRS's relatively accurate average level of FC receipt seems to correspond to a good representation of the distribution of receipt. In the FES results are slightly further from administrative totals, but in this much smaller survey, random variation is more likely to be significant when looking at the distribution of an income source within a small sub-sample of the overall population.

In the 1996/7 FRS, the distribution of receipt is slightly less accurate when we look at lone parents and couples separately. But the official figures remain comparable to those in the FES. Table 2.4 shows how these distributions compare with that from official figures. Tables in the Appendix 1 for 1994/5 and 1995/6 make it clear that the distribution of entitlement within these two groups of claimants is again less accurately representative than the overall distribution. The divergence with official figures does not look systematically biased, however, and it is likely that the role of random variation is simply becoming more important as we look at smaller groups of the population.

Table 2.4 Distribution of receipt for lone parents and couples in the 1996/7 FRS

Amount of FC (£s per week)	Fraction recipients in the FRS	Fraction recipients in official figures
Lone parents		
<£30	12%	12%
£30 - £60	44%	48%
>£60	44%	40%
Couples		
<£30	23%	23%
£30 - £60	38%	33%
>£60	39%	44%

2.1.3 Size of family

Number of children is an important determinant of the amount of credit that a family will get. Furthermore, one of the results of modelling reforms to FC that we might be interested in is how it differentially affects families of different sizes.

Table 2.5 shows the degree of under–representation of families with different numbers of children in the FRS for each year from 1994/95 to 1996/97. We can see that for this year the FRS gets the fraction of recipients with 3 or more children exactly right, but that it relatively over-represents the fraction with two children relative to the number with just one child. For earlier years of the FRS, though, we find it is those with the largest families that are the slightly under-sampled. The implication is that there is no systematic bias in the survey. We can also be happy that the mix of families of different sizes amongst FC recipients is reasonably representative.

Table 2.5 – FC recipients in the 1996/97 FRS, by numbers of children

Number of Children	Fraction of recipients in the FRS	Fraction of recipients in official figures
1	35%	37%
2	40%	36%
3+	26%	26%
Totals	100% (total number 532,000)	100% (total number 725,000)

2.1.4 Employment status

Both families headed by the self-employed and those where the main earner is an employee can claim FC. How representative is the FRS in terms of the balance between these two groups in its FC claimants? Table 2.6 suggests that the mix is reasonable.

Table 2.6 – FC recipients by economic status in the 1996/97 FRS

Economic status of main earner	Fraction of total in the FRS	Fraction of total in official figures
Not self employed	89%	86%
Self employed	11%	14%
Totals	100% (total number 532,000)	100% (total number 725,000)

As far as the average payments to the two groups goes, the FRS again compares reasonably well to the administrative data, as Table 2.7 shows.

Table 2.7 – average payment of FC by economic status

Economic status of main earner	Average payment in the FRS	Average payment in the DSS
Not self employed	£52.99	£55.16
Self employed	£73.99	£62.79
Totals	£55.40	£56.92

2.1.5 Distribution of earnings

The final important determinant of FC entitlement is earnings – entitlement is reduced as earnings exceed the applicable amount. Table 2.8 compares the distribution of the earnings of recipient families' main earner found in the FRS for 1996/7 with that found in administrative data.

The first thing to compare is the average pay of the main earner in families receiving the benefit. The FRS has notably higher average earnings that administrative figures - £125.32 rather than £112.81. Does this higher average reflect a different distribution, with the FRS sample skewed towards the higher end of the actual earnings distribution of recipients? Table 2.8 gives a slightly more complex message. The FRS over-represents people in the lowest earnings bracket, but under-represents the next lowest two groups, and over-represents the top end.

The over-representation at the very bottom end reflects the fact that no-one is currently earning in 6% of the families receiving the benefit in the FRS – without grossing this group is 38 families. These are people who are claiming FC even though they are not currently working – this is possibly because of the six-monthly gap between assessments. If we were to ignore these families it would become clear that the sample as a whole relatively over-represents recipients on higher wages compared to the data recorded in administrative records. The difference between the mean level of earnings in the FRS and the level of earnings in official figures would grow further. We will consider why this might be so in Section 3.4, when we consider people who have receipt in the data, even though we model them as being without entitlement.

Table 2.8 –earnings of all FC recipients – 1996/7 FRS

Earnings of main earner	FRS – fraction of recipients	Official figures – fraction of recipients
<£40	9%	5%
£40 – 80	24%	32%
£80 – 120	18%	22%
£120 – 160	18%	17%
£160-200	14%	14%
>£200	16%	10%
Total	100%	100%
	(total number 532,000)	(total number 725,000)

The FRS suggests a mean level of earnings for lone parents which is close to that recorded by the group in the claims process. The mean earned income in official figures is £95.37 for this group, whereas in the FRS it is £100.41. This contrasts to the way that the survey suggested a level of average earnings well above the officially recorded level for FC recipients as a whole.

Repeating the analysis of Table 2.9 for lone parents alone reveals that for this group there is little over-representation at the top end of the income distribution. The important difference between the FRS sample and the lone parents recorded in official figures is the significant over-representation at the bottom end. This is because most of the recipient families with no main earner in the FRS (23 of the 38) are lone parents.

Table 2.9 –earnings of lone parent FC recipients - 1996/7 FRS

Earnings	FRS – fraction of recipients	Official figures – fraction of recipients
<£40	15%	4%
£40 – 80	33%	40%
£80 – 120	21%	26%
£120 – 160	17%	15%
£160-200	9%	9%
>£200	5%	5%
Total	100%	100%
	(total number 227,000)	(total number 329,000)

For the other group of recipients, couples, the earnings data in the FRS seems less representative of that recorded in the claims process – especially at the top end. The mean earnings of the main earner amongst recipient couples was £147.76 in the FRS. But at the time of claiming the average couple recorded just £123.12. Table 2.10 makes it clear that the FRS relatively under-represents couples in the bottom half of the recipient earnings distribution, and relatively over-represents that at the top end.

Table 2.10 –earnings of couple FC recipients - 1996/7 FRS

Earnings	FRS – fraction of recipients	Official figures – fraction of recipients
<£40	6%	7%
£40 – 80	17%	25%
£80 – 120	16%	18%
£120 – 160	18%	18%
£160-200	18%	17%
>£200	24%	14%
Total	100%	100%
	(total number 304,000)	(total number 396,000)

The tables in Appendix 1 make it clear that the general results that we have here apply to other years as well. In each year of FRS the survey relatively over-represents both the very top and the very bottom of the FC recipient earnings distribution. Over-representation at the bottom end is the product of people being on zero wages (i.e. – having moved out of work), and chiefly affects lone parents, and the over-representation of those on high wages chiefly affects couples. The average wage of recipients is always higher in the survey than in official figures, with the disparity being higher for couples. And all these results hold for every year of FES as well. In Section 3.4 we will be looking at people who still receive FC because of its six monthly assessment, even though they lack entitlement on the basis of current circumstance. This can reflect either families moving out of work or their incomes having changed. This discussion will shed some light on the differences between the earnings distribution observed in the survey data, and that observed in official records.

2.2 The effect of 'grossing up' the data

The one major concern with the input data is the consistent and substantial under-representation of the numbers of families of FC. One possible cause of systematic under-representation is the 'grossing' that comes with the survey. 'Grossing' is the process of applying factors to sample estimates so that they apply to the entire population. The simplest way to do this would be to apply a uniform weight to each observation, calculated by dividing the number of households in the population by the number achieved in the sample. So, if, for example, the FRS samples one in one thousand people, then the results for each person in the survey is multiplied by 1,000 when interpreting the sample as a picture of the population. But most surveys, including the FRS, use a more complex grossing scheme, which attempts to correct for the differential non-response of different groups in the population. For example, we may know from the census that a certain proportion of households contains single adults. We may find that this group is under-represented in our survey, and it is possible to increase the relative weight of this group. In this way we can ensure that the survey is forced to be representative of population in particular dimensions[4]. Tax and benefit models, like TAXBEN, normally apply such differential grossing factors to each family in their output results.

The grossing scheme supplied by the DSS, along with the FRS data, 'corrects' for differential non-response in four dimensions: family type/age, Council Tax band, region and tenure. The full list of categories in each dimension that affect the grossing factor that each family receives is given in Appendix 4. To discover whether grossing is contributing to the under-representation of FC recipients in the FRS we need to compare the average weight that a recipient has with that that of the sample average. The average family in the FRS is weighted at 962, but FC recipients are weighted at an average of 833. This means that the grossing scheme is depressing the proportion of FC recipients that we see in the survey. Table 2.11 re-weights the 1996/7 using uniform grossing factors and reveals that much of the under-representation of FC recipients in the survey is down to the grossing scheme. The proportion of FC recipients in the sample, both lone parents and couples, increases very significantly when uniform weights are applied, and the total numbers are thus left much closer to, though still under, the administrative totals.

Table 2.11 – FC recipients in the 1996/7 FRS

Family type	Admin data (1000s)	Differentially grossed FRS % admin (1,000s in brackets)	Non-differentially grossed FRS % admin (1,000s in brackets)
Lone parents	329	69% (228)	81% (268)
Couples	395.9	77% (304)	87% (343)
All Claimants	725	73% (531)	84% (611)

[4] See (Andrew Ray, Analytical Services Division DSS, 1996, Analytical Notes: Number 5 *Grossing Up – An Investigation of Different Methods Applied to Data From The Family Resources Survey.*) for a detailed discussion of how the grossing scheme of the FRS was settled on.

The most important reason for this under-weighting is likely to be the relatively low weights that families with children are given relative to the sample average. The average lone parent family has a grossing factor of 802, compared to a sample average of 962. The average weight for couples with children is 864. These lower weights are given to families with children to compensate for the higher average response rate of these groups. But the implication of Table 2.11, which shows that FC recipients are under-represented even without differential weighting, is that the differential weighting scheme is worsening the survey's degree of representation in one of the dimensions that it does not attempt to correct for – FC receipt. It may be that this sub-class of families with children has a much lower propensity to respond to the survey than others. The difference in response rate between families with children who receive and do not receive FC could reflect any underlying dimension of variability that is not corrected for by the weighting scheme, and which affects both one's likelihood of responding to the survey, and one's likelihood of receiving FC. Possibilities of such dimensions might include economic status, hours worked and earnings.

The weighting scheme of the FES also aggravates the problem of under-representation of FC recipients. The average weight of a benefit unit in the FES in 1996/97 is 4,116, but for FC recipients it is 3,179 – almost 25% smaller. Again, it turns out that the low weights of FC recipients are the product of the low weights applied to families with children overall – the average weight for a family with one child or more is 3,240, very similar to the average weight applied to FC recipients.

3. Problems in Modelling Family Credit

In this section, we compare the TAXBEN calculation of FC entitlement with both the official records on the benefit, and with the receipt of benefit recorded in the model's input data. We then look in detail at those whom TAXBEN calculates as entitled to benefit even though they do not record receipt in the data. We consider how modelled output might be adjusted in the light of this group. Finally, we consider the implications of those who appear to be receiving benefit in the data, even though TAXBEN does not calculate that they are entitled to it, for tax and benefit results.

3.1 How does the model's output compare with official figures?

3.1.1 Numbers on Family Credit

Aside from problems with the input data, two groups of families cause divergence between the output and benefit entitlement, obtained from a tax and benefit model, and the true figures describing receipt of that benefit. First, families that are awarded entitlement by the model but who record no receipt in the data. All else being equal, this group leads to models over-estimating the numbers claiming relative to official records. Secondly, families who report receipt of the benefit in the data, but which the tax and benefit model does not calculate as eligible. Abstracting from all other problems, the existence of this second group means that the model would under-estimate the number receiving the benefit relative to administrative records. Comparing TAXBEN output with the official figures on FC, as Table 3.1 does for each year of FRS & FES data, reveals that overall it consistently awards the benefit to more people than actually receive it. This suggests that it is the first of the two 'problem groups' that is the numerically dominant one.

There is marked variation in the degree of over-representation of FC entitlement coming out of the model for different years, but nonetheless there is over-representation for every year. In much of what follows we will focus on one set of results, those from the 1996/97 FRS, but we will refer to results from other data sets where these differ from the main set of results in an interesting way. Results tables in Appendix 1 give some detail of how TAXBEN's output for other data sets compares with the relevant administrative data.

Table 3.1. Official figures on FC receipt compared to numbers entitled from TAXBEN

Financial Year of data and tax and benefit system	Number with modelled entitlement as proportion of total receiving	
	Model run on FRS	Model run on FES
1994/95	119%	127%
1995/96	130%	125%
1996/97	112%	118%

3.1.2 Family type

Table 3.2 shows how the difference between modelled entitlement and officially recorded receipt breaks down by lone parents and couples for the 1996/7 FRS. In spite of the overall overestimation of the numbers on FC we see that TAXBEN actually calculates FC entitlement for fewer lone parents than receive it. It seems that the overall excess in the numbers modelled as being entitled to FC over the numbers actually receiving it is due to a large number of couples who are apparently entitled but without receipt.

Table 3.2. Official figures on FC receipt compared to numbers entitled from TAXBEN – 1996/7

Financial Year of data and tax and benefit system	Number in official figures (1,000s)	Number TAXBEN calculates entitled (1,000s)	Number TAXBEN entitlements as a proportion of numbers receiving
Lone parents	329	260	79%
Couples	396	553	140%
Total	725	814	112%

In spite of significant variation in the precise figures for lone parents and couples across years and between the surveys, the tables in Appendix 1 make it plain that the broad pattern of results of Table 3.2 holds generally. TAXBEN over-estimates the number of couples receiving FC every year. Over-representation of couples modelled to be on the benefit ranges from ranges from 131% to 155%. In contrast, lone parents are under-represented in each of the six surveys that the appendix gives results for, except for the 1994/5 FES, where one-parent families modelled as being on FC exceeds the actual number.

3.1.3 Amount of Family Credit received

Table 3.3 shows that TAXBEN relatively overestimates the numbers receiving low levels of FC and relatively underestimates the numbers on larger amounts of FC. The mean amount of modelled entitlement is £45.74; the mean amount of receipt in the administrative data for November 1996 was £56.92.

Table 3.3. The distribution of modelled entitlement from the 1996/7 FRS compared to that in administrative data

Amount of FC (£s per week)	Fraction of total in the FRS	Fraction of total in official figures
<£30	35%	18%
£30 - £60	34%	38%
>£60	31%	44%
Total	100% (Total number 815,000)	100% (Total number 725,000)

The tables in Appendix 1 make it plain that this pattern of relative over-representation of those on smaller amounts of FC in the modelled results holds across years, across data

sets, and for both lone parents and couples. One possible reason for this result is that people with lower levels of FC entitlement are less likely to take-up their benefit.

3.2 How well does modelled entitlement match reported receipt?

Overall, TAXBEN overestimates the number of families receiving FC relative to the numbers recorded as receiving in official figures. But how well does the modelled entitlement match with the reported receipt in the FRS? As the FRS systematically under-represents FC recipients, it is to be expected that the difference here will be greater still.

For each family in the FRS there are four possible configurations of entitlement and receipt: they may have modelled entitlement and recorded receipt; they may be without either; they may be modelled as entitled without recording any receipt; or, they may report receipt even though TAXBEN does not give them any entitlement. Table 3.4 shows how the FRS splits between these groups. The first thing the table shows is that there are significantly more with entitlement than receipt – 815,000 families as against 532,000. The percentage breakdown of those with entitlement and those with receipt is also shown.

Secondly, the majority of those modelled as being entitled, 52%, do not actually receive the benefit. We shall call this proportion the 'non take-up rate', which is the fraction of those with entitlement who report receipt. The corresponding raw 'take-up rate' is 48%. It should be noted that this is just a shorthand name for this statistic – it does not represent our estimate of benefit take up rates, as there may be reasons other than non take-up that explain the non-receipt of benefit found in the group. Consequently, the raw take-up figure, of 48%, is much lower than the official estimate of FC take-up undertaken by DSS, which puts take-up at 72% by caseload. The DSS estimate reflects a much more complicated calculation than that which produced our raw figure[5]. In Appendix 2, we consider the refinements that can be applied to tax and benefit model output in order to try and estimate benefit take-up rates more accurately. We will refer to families with modelled entitlement who do not report receipt of FC as Entitled Non-Recipients - ENRs.

But Table 3.4 also makes it clear that there is substantial mismatch running in the opposite direction. Of those who do report receipt of the benefit, just over a quarter (26%) are modelled as being without entitlement. We call this figure the 'lag rate' because one likely reason that many people may receive without appearing entitled is that there is a lag of up to six months after a recipient's circumstances (e.g. wages, hours) change before it is necessarily required that the FC system knows about these changes. So, a family's circumstances might change in a way that means a fresh claim for FC would be rejected, but they can legitimately continue to receive FC on the basis of an old claim until (after a maximum of six months) they are actually required to re-apply for assessment. A family whose circumstance changed in just this way between their last FC application and the completion of the FRS interview would appear as receiving but

[5] Income Related Benefits: Estimates of Take-Up in 1996/7, DSS Analytical Services Division, Corporate Document Services, Leeds. It should be noted that DSS estimates were revised in a subsequent edition.

without entitlement. Again, we do not mean to imply by this shorthand that this lag is the only reason for apparent receipt without entitlement. Other possible reasons for receipt without entitlement include delays or mistakes in the benefit agency's processing of information, mistakes in the model's computer algorithms, fraud, and differences between the income information asked for by the FC claims form and the FRS. We will refer to families who report receipt of the benefit, but who lack modelled entitlement on the basis of current income and circumstances as Non-Entitled Recipients - NERs.

NERs and ENRs can both be contrasted with the group of families for whom the model and the data agree on FC being received. We will call this group Entitled Recipients - ERs.

Table 3.4. FC entitlement and receipt in the 1996/97 FRS

	Thousands not modelled entitled to FC	Thousands modelled entitled to FC	Totals
Thousands not recording FC in the FRS	28,248	421 (52% of the entitled)	28, 669
Thousands recording FC in the FRS	138 (26% of recipients)	394 (74% of recipients, 48% of the entitled)	532
Totals	28,386	815	29,201

Note: IGOTM is the Treasury's tax and benefit model. Table refers to how it operated in 1999.

In short, there is substantial mismatch between those reporting receipt of FC and those that TAXBEN models as entitled. This is the product both of a substantial lag rate, 26%, and a high raw non-take up rate – 52%. If entitlement were perfectly matched with receipt then both figures would be zero. The remainder of this section of the report is concerned with why there is such a mismatch, and what, if anything, tax and benefit modellers can do to correct for it.

3.2.1 The effect of different income measures

One possible cause of the mismatch between modelled entitlement and receipt would be that the income that TAXBEN uses for calculating eligibility for FC differs from that actually used by the benefit system. Differences between the income measure that the model uses and that that the benefit system requires could lead to both receipt without apparent entitlement (contributing to the lag-rate) and entitlement without receipt (contributing to the raw non-take-up rate).

The income that TAXBEN normally uses to calculate eligibility for all means-tested benefits has two particular features that might be thought to differ from that used by the benefit system. First, TAXBEN *models* net income from the gross income reported in the data – that is neither tax and national insurance payments nor receipt of non-means tested benefits are taken straight from the data, but are instead calculated by the model's algorithms. The model then adjusts total net income in the light of this. If there are important differences between the tax payments and non-means tested benefits that individuals claim to have, and those that the model calculates for them, then TAXBEN's

use of modelled income means that these differences will have knock on effects on FC. Secondly, the employment income measure normally used by TAXBEN is current – i.e. – based on the wages received last time. But the benefit system determines FC eligibility by what the claimant's income has been on average over the past few weeks or months. A measure of income based on usual wages might, therefore, be thought more appropriate.

Table 3.5 summarises the four possible configurations of income that flow from the preceding discussion. Of the four configurations in the table, TAXBEN currently uses the measure in the bottom left hand corner. We will consider changing each of the two choices about income measure in turn, examining how the use of current, modelled and then usual, reported income affects results. The nature of the FRS questionnaire renders the possibility of usual, reported income incoherent, because usual income is recorded gross, but the questions about tax always refer to the current (most recent) period, which makes it impossible to subtract these payments to get back to a usual net measure.

Table 3.5 Summary of different possible measures of income

		Time period over which earnings assessed	
		'Current' - last pay period	'Usual' – typical pay period
Reported or modelled income tax, NI and non-means-tested benefits?	Reported	Current, reported	Usual, reported – The FRS's questions mean this cannot be coherently calculated.
	Modelled	Current, modelled - TAXBEN's standard input income.	Usual, modelled – IGOTM's standard input income.

Note: IGOTM is the Treasury's tax and benefit model.

Table 3.6 compares how TAXBEN's standard output is changed by both a switch to using usual income measure, and by a switch to using reported income. We can see that the switch to reported income, as opposed to modelled income, has no significant effect on our summary measures of the extent of matching between entitlement and receipt. Switching to usual income, on the other hand, effects a very slight improvement in the degree of matching, but the high rates of 'non-take up' and 'lag' are not substantially cut. It seems that the choice of income measure cannot be responsible for any major part of the mismatch that we see between entitlement and receipt. For the rest of this section of the report, we therefore focus on results generated using TAXBEN's standard income measure.

Table 3.6. The effect of changing income measures on results from 1996/97 FRS

Income type	Non take-up rate	Lag rate
Current, modelled	52%	26%
Current, reported	52%	26%
Usual, modelled.	51%	25%

3.3 Entitlement without receipt

The biggest cause of the mismatch between families that record receipt of benefit in the FRS and those that we model to be entitled is the group of families with apparent

entitlement but no receipt. This group is so large that it leads TAXBEN to overestimate the numbers of families on FC, even though it is being run on data that under-samples the benefit's recipients. In this section we look at which types of families seem particularly likely to fail to claim their entitlement before going on to ask how the output of tax and benefit models can be adjusted in the light of the problem.

3.3.1 Characteristics of those failing to take-up entitlement

However exactly non take-up is measured, it is clear that there is a substantial number of households, running into hundreds of thousands, who are modelled to have entitlement to benefit but who do not claim. In this section, we compare the characteristics of those who do receive benefit with the characteristics of those who do not receive it, in spite of having entitlement. We use TAXBEN output together with FRS data for 1996/97 to identify the group – it is all those who report no receipt but who TAXBEN models to be entitled. Raw 'take-up' rates for families with different characteristics are shown in Table 3.7 and discussed below.

Table 3.7. 'Take-up' rates amongst families with different characteristics

	Take-up rate (%)
Employment status	
Someone in family self-employed	24%
No-one in family self employed	57%
Family Type	
Single parent	67%
Couple	40%
Banded amount of entitlement	
<£30 per week	29%
£30 - £60 per week	57%
>£60 per week	61%
Total	48%

- *Employment status* - Table 3.7 makes it very clear that families with a self employed member have a much lower raw take-up rate than the average. The Family Credit system uses a different definition of self-employment income from the FRS, and this may explain part of the discrepancy. In addition, as we discuss in Appendix 2, there is reason to think that FRS income data on the self employed is unreliable.

- *Family Type* – the table shows that the raw take-up rates suggest important differences between family types. A far higher fraction of one-parent families than couples seem to take-up their entitlement.

- *Amount of entitlement*- We might expect the amount of entitlement that a family has to affect their propensity to take-up benefit entitlement. If we imagine families as trading off the hassle (and perhaps stigma) that they face when they apply for means-tested benefits against the expected financial gain from claiming, then if they have sufficient information to make an estimate of how much benefit they would be entitled to (even if only a very rough estimate), then those with higher level of entitlement will be more likely to claim. Table 3.7 confirms that there does indeed

appear to be an important effect of the amount of entitlement that a family has on their propensity to take-up benefit. Those with less than £30 a week in entitlement are less than half as likely to receive their benefit than those with over £60.

3.3.2 Implications of imperfect take-up for modelled results

All else being equal the high fraction of those that we model as entitled who do not appear to take-up their FC will lead TAXBEN to award significantly more FC entitlements than there are people who are actually in receipt of the benefit. This is because models are normally concerned with entitlement – the notional workings of the benefit system – rather than with receipt of benefit. But the consequence of focussing purely on the notional workings of the system can be to leave modelled results less useful to policy makers. If no allowance is made for non-take-up, the model will overestimate the cost of the benefit, and the numbers affected by it. Its results will also exaggerate the fiscal and distributional implications of changing the generosity of the benefit.

Not only will ignoring the effects of non-take up lead to over-estimation of the overall importance of FC, but because families with different characteristics have (as we saw in Table 3.7) different propensities to take-up benefit, it will also lead to TAXBEN producing a misleading picture of recipients. For example, the low take-up rate amongst couples means that this family type will be over-represented amongst those with modelled entitlement relative to lone parents; i.e. a higher proportion of those with modelled receipt will be couples than is found amongst those actually receiving benefit. In Section 3.1.2 comparison with administrative data revealed that this relative over-representation of couples amongst those with modelled entitlement is exactly what happens. The same is true for self-employed families, whose low propensity to take-up apparent entitlement means that TAXBEN relatively over-estimates the share of FC recipients who are in self-employment. The low take-up rate amongst those with low levels of entitlement means that TAXBEN will also err in estimating the distribution of entitlement – there will be relatively too many individuals with low levels of entitlement. Section 3.1.3 showed that this is exactly what was found in the modelled results.

3.3.3 Adjusting for take-up within the tax and benefit model

If tax and benefit modelling output is to be used to inform policy decisions, then it is clearly important to adjust results for the systematic errors produced by non-take up that we identified in the previous section. For only if such adjustment is made will it be possible to model accurately the true fiscal and distributional effects of a reform under consideration. The adjustment process must involve working out how likely we think particular individuals are to take up benefit - only in this case will it be possible for the adjusted results to continue to be informative about the distributional effects. The basic approach is to estimate these probabilities and apply them to the modelled results, thereby incorporating the effect of non-take up in model output.

We can use statistical techniques to estimate from the data the impact of a range of characteristics on the likelihood of families taking up their FC entitlement. Probit regression provides a convenient means to produce such estimates. We took the sample of families with modelled FC entitlement in the 1996/97 FRS, and used probit regression

to examine the effect of various characteristics on whether or not the families actually recorded receipt of FC in the data. Amongst the characteristics that we included were amount of FC entitlement, age, tenure type, region, age education ceased, non-labour income, and income of any co-residents outside the immediate family. A full set of the regressors used and the results produced are contained in Appendix 3.

Separate estimates were made for the couple and one-parent family groups. Different family structures might be expected to mean that different factors would be relevant to whether or not benefit is taken up. And the difference in the raw take-up rate of the two groups is so large that it seems highly unlikely that exactly the same processes are at work in determining how likely the two groups of families are to take up their benefit.

Crucially, we excluded the self-employed from the estimation process entirely. This is because we judge the data problems concerning their income, discussed in Appendix 2, so important. Income data problems for this group means that we are likely to be modelling entitlement for many households who in fact would not qualify, and we do not want to make the mistake of allowing this apparent non-take-up to be counted in our estimation process in the same way as genuine none take-up. Exclusion of the self-employed boosts the take-up rate significantly. It also reduces the differential in take-up rates between lone parents and couples, since the significant number of self-employed people with modelled entitlement who do not receive any benefit are disproportionately couples.

Once we have the estimates, applying them to modelled results is straightforward. The grossing factor of each family is simply multiplied by its likelihood of taking up benefit. The results for FC are then grossed up using with these adjusted factors – the number of individuals that each family with modelled FC entitlement is taken to represent now depends on the estimated likelihood of that family to take up their benefit entitlement. The adjusted results will show fewer people being on FC overall, and there will be especially big falls in the number of families who fall into groups that are especially unlikely to claim any entitlement to benefit who are modelled as being on FC.

The same adjustment is made for self-employed families as for others, even though they were excluded from the estimation process. The implicit assumption is that the difference in apparent take-up rates between employees and the self-employed is entirely a product of the data and definitional problems with self-employed incomes: i.e. self-employment is not in itself a characteristic which affects one's likelihood of taking up.

3.3.4 Adjusted results

(a) Numbers on Family Credit

Table 3.8 shows how bringing non take-up to bear on modelled results for FC leaves the TAXBEN's estimation of the total number on the benefit, compared both to administrative totals and to the unadjusted results.

The second column of the table shows how the adjustment sharply reduces the number of families that TAXBEN calculates as being on FC. Overall, once the adjustment has been made, the model puts the total number on FC at 55% of its original level. The fall

in the estimated numbers of couples on the benefit is particularly steep, reflecting the lower take-up found amongst this group. The effect of this is to reduce the fraction of couples amongst the group modelled as receiving. We saw in C1(b) that couples were relatively over-represented amongst the group modelled as being on FC, so the adjustment improves the quality of TAXBEN's picture of FC recipients in this dimension.

The lower half of the table compares the adjusted estimate of the number on the benefit with the administratively recorded total who were actually on the benefit in 1996/97. It shows that, in stark contrast to the unadjusted modelled results, the estimates adjusted to account for non take-up leave TAXBEN under-estimating the numbers on benefit very significantly. There are two reasons for this. First, because although we have adjusted for non take up, we have taken no account of the other group that drives differences between the model's estimate of who is on FC and the truth – those who record receipt but who are modelled as being without entitlement. In Section 3.2 we saw that one in four of those reporting receipt fell into this category. Abstracting from take-up and all other problems, the effect of this group is to leave the model under-estimating the numbers on benefit. We will turn to consider whether we can do anything about this group in the next section of his report.

Secondly, a further degree of under-estimation arises because of the under-representation of FC recipients in the original data. The estimates for the likelihood of taking up FC that we produced were calculated from a combination of model output the and the raw FRS record of who actually claims the benefit. The best that using any such technique can achieve is to get the results back to correspondence with the data. But as the original FRS under-represents FC recipients, as we saw Section 2, then, all else being equal, the adjusted results will do the same. Adjusting modelled results in the light of what is found in the input data can never solve problems in that input data in itself.

Table 3.8. Adjusted results compared with unadjusted results and known totals on benefit

Family Type	Adjusted number on FC	Adjusted count as fraction of unadjusted count	Adjusted count as fraction of administrative count
Lone Parents	177	68%	54%
Couples	267	48%	67%
Total	444	55% (Total unadjusted count – 814,000)	61% (Total official count – 725,000)

Note: all totals include self-employed.

(b) The adjusted distribution of entitlement

Table 3.9 shows how adjustment for non-take up has produced a dramatic improvement in the modelled distribution of entitlement. Whereas the unadjusted model results hugely over-represented the proportion of claimants with very low levels of entitlement, the adjusted results match the administrative numbers very closely. As the figures showing

the probit results in Appendix 3 make clear, there is a statistically significant and positive relationship between the amount of entitlement that an individual has and their propensity to take up benefit entitlement. Consequently, the adjusted grossing factors reduce the numbers of individuals that TAXBEN calculates as being on very low levels of receipt especially sharply.

Table 3.9. Actual distribution of entitlement compared with adjusted and unadjusted model results

Amount of entitlement	Fraction of administrative count	Fraction of unadjusted modelled results	Fraction of adjusted modelled results
<£30	18%	35%	22%
£30 - £60	38%	34%	35%
>£ 60	44%	31%	43%
Total	100%	100%	100%

3.4 Receipt without entitlement

3.4.1 Why is there receipt with no entitlement?

Aside from those failing to take up their benefit entitlement, the other group of families that that causes a divergence between modelled results and those we find receiving in the data are those who report receipt, even though the model deems them to be without entitlement. There are a number of possible reasons why families might fall into this category – administrative error, mistakes in computer algorithm, erroneous measurement of circumstances in the household surveys and fraud are all possibilities. But as well as all these possibilities, uniquely amongst UK means-tested benefits, there is an additional possible explanation in the case of FC: the financial circumstances that determine eligibility for the benefit can lag those that a family is currently in by several months.

Entitlement for FC is assessed on the basis of what a family's *normal* income has been over the last few weeks (the precise period over which the assessment applies depends upon the way in which an applicant is paid for their employment). Further, once granted, entitlement continues for six months, regardless of whether the family's financial circumstances change. In contrast the questions about income and work in the FES or FRS, which form the basis for model input, are typically concerned with uncovering details of individuals' work over the very recent past – the last week or two. This difference between the information available in the model's input data and the information that actually determines FC entitlement (which is an average of three months out of date), means that some families will not appear as entitled. Some will have moved out of work, which would disqualify them from FC were they to face a fresh claim today; others may have seen incomes increase sufficiently to mean that they would lose all entitlement through means-testing. Changes in circumstances might be expected to be especially likely as FC's rules produce a strategic incentives to change behaviour when the means-test is applied: individuals can reduce earnings (perhaps through cutting hours) in the weeks before assessment, thereby boosting entitlement, before returning to a higher level of hours and earnings after the means-test is applied.

The effect of the group of recipients who lack entitlement is, all else being equal, to depress the count of modelled FC claimants relative to the true count. In this section we consider how much we can find out about families with receipt and no entitlement and whether there is anything that we can do to adjust the results of models in their light.

3.4.2 The scale of the problem

In the 1996/97 FRS, the total number of benefit units receiving FC without entitlement is 164, which grosses up to suggest that there are 138,000 benefit units in the country in this situation. Overall, this means that 74% of families with reported receipt of FC are modelled as entitled, while 26% are without entitlement.

One method of estimation of the fraction of recipients who fall into the NER group is employed by DSS, when they adjust take-up figures in recognition of the fact that there are some families that are not taking up legitimate benefit entitlement, even though would appear from data to be without entitlement (see Appendix 2 for details). They estimate the fraction of entitlements that reflect current (rather than lagged) circumstances using the fraction of claimants who successfully renew their FC claim after six months. Their method assumes that all those who renew their FC claim have been entitled on the basis of current financial circumstance throughout. This assumption ignores the possibility that some people's circumstances change so that they temporarily lose entitlement between six monthly assessments, but that they will be eligible again by the time that their claim comes up for renewal due to a second change in circumstances. It also ignores the possibility that strategic earnings reduction immediately before the six-monthly means-tests is producing a significant amount of receipt which can not be explained by current circumstance.

For both these reasons we might expect DSS estimates of the share of recipients without entitlement to be lower than those produced by our examination of the modelled entitlement of those reporting receipt in the FRS. This is borne out by the figures – DSS estimates that the proportion of lone parent recipients with entitlement is 86%, for couples it is 81%. Our comparison of receipt with entitlement puts the figures respectively at 77% and 73%.

3.4.3 Characteristics of those receiving without entitlement

(a) Labour-market characteristics

Self-employment is found in similar numbers amongst those with receipt and entitlement (ERs) and those with receipt but no entitlement (NERs). Just over 10% of both ERs and NER families contain a self- employed adult. We ignore the self-employed in the rest of the results in this section so the results are not contaminated with the data problems and consequent incorrect modelling of FC that attempting to calculate results for them produces. A further reason for their exclusion from this section is that we do not have a measure of hours worked for the self employed that compares with that we use to assess employees.

Workless families - Aside from the self employed, 100% of ER families have one or two employees in them, but 27% of families classed as NER contain no employee. This suggests substantial continuing payment of FC to those who have moved out of work.

Hours Worked - We divide hours into three groups – families where the main earner works less hours than would normally be needed to qualify for FC (a few may still qualify on the basis of hours of spouse) , families where main earner is part timer (16 – 36 hours), and families where the main earner is full time.

Table 3.10. Weekly hours worked for recipients with and without entitlement

Hours of main earner	Receiving and entitled	Receiving without entitlement
<16		40 %
16 – 36	57 %	20 %
>=37	41 %	40 %
Total	100%	100%

We can see that the most important difference is the very large number of people who are receiving without entitlement who are clustered below 16 hours. Of these most are actually at zero hours. This group may have moved out of work altogether but continues to receive FC until the next means test. Interestingly, most of those with receipt but no entitlement who work zero hours receive no income support (59%), and the average income support payment amongst non-entitled recipients at zero hours is just £8.30, suggesting that FC is playing a crucial role in these families' finances. Others are working just a little less than 16 hours, which (if they are the only adult in the household) means that they lose entitlement to FC – their hours are likely to have fallen a little since the last FC assessment[6].

The second thing to note is that the ratio of full timers to part timers on more than 16 hours is very different across the two groups in Table 3.10. Table 3.11 repeats the analysis of Table 3.10, but excludes all those who are working less than 16 hours. The table makes clear that, ignoring those working insufficient hours to qualify for FC, those receiving without entitlement are much more likely to be working full time. One possible explanation is that significant numbers of individuals increase the number of hours that they work over the months, as they become established in a job. Another way of interpreting the finding is as evidence for people cutting their usual hours in the run up to the means test, before resuming their 'normal' hours, which sees their wage increase to the extent that many are floated off FC altogether.

Table 3.11. Weekly hours worked for recipients with and without entitlement

Hours of main earner	Receiving and entitled	Receiving without entitlement
16 – 36	59 %	33%
> 36	41 %	67 %
Total	100 %	100 %

[6] A very small number of families with entitlement and receipt have their main earner working less than 16 hours. In the case of couples, this is possible because the other partner, even though they earn less than the main earner, is working more than 16 hours.

Earnings are closely related to the number of hours worked for part-time employees. Figure 3.1 makes it clear that FC recipients without entitlement are much more likely to be earning at the very top or bottom end of the distribution for recipients. Those who have ceased to be eligible on the basis of current income since their last assessment for FC have typically either moved out of work entirely (or cut their hours below 16) leaving them with very low levels of earnings, or else received an increase in earnings, which could reflect either increased hours, or else a pay rise. For the first group, the reduced hours are likely to be the cause of loss of eligibility; for the second, the cause would typically be excessive income.

Figure 3.1. The distribution of earnings for recipients with and without entitlement

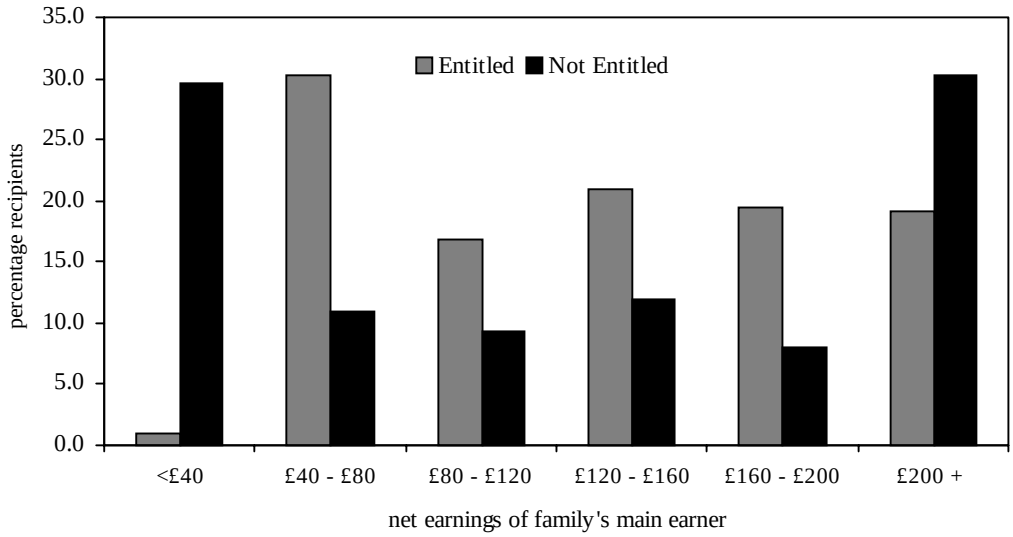

Table 3.12 repeats the analyis of the figure, but excludes those families whose main earner is working less than 16 hours. The table thus contrasts the earnings distribution of ERs with the distribution for that for those NERs whose entitlement who has not lost eligibility due to working insufficient hours. The interesting line is the last one on the table – NERs are almost 5 times more likely to be earning more than £200 per week than ERs, suggesting that high earnings are a crucial reason why entitlement to FC is lost.

Table 3.12. The earnings of recipients with and without entitlement

Wage of main earner	Receiving and entitled (%)	Receiving without entitlement (%)
<£40	1 %	2 %
£40 - £80	30 %	4 %
£80 - £120	20 %	12 %
£120 - £160	21 %	19 %
£160 - £200	18 %	13 %
£200 +	10 %	49%

The overall average earnings of the main earner in ER and NER families are similar, masking the different distributions. It stands at £123 for non-entitled recipients, and £132 entitled recipients. But if we exclude those on less than 16 hours – likely to have lost all entitlement because of failing the hours rule – we find the difference is dramatic. For ERs average earnings are just £123.81, as against £202.82 for NERs

(b) Family type

Couples and single parents receiving FC are similarly likely to lack entitlement. Table 3.13 shows that one parent families are relatively a little less likely to be receiving without entitlement. This is exactly what the DSS methodology for adjusting take up in the light of NERs[7] would lead us to expect: lone parents are more likely to get their FC renewed than couples, which reflects the fact that they are more likely to be entitled on the basis of current income at any one time.

Table 3.13. Family type of recipients with and without entitlement

Family type	Receiving and entitled	Receiving without entitlement
Lone parent	48 %	42 %
Couple	52 %	58 %
Total	100%	100%

The fairly similar overall family type composition of the ER and NER groups, masks important differences in the composition of the NER group. If we think of NERs as falling into two broad categories, those who are likely to have lost current eligibility to FC due to having increased their income since the last means test, and those who have lost it due to either a cut in their hours, or indeed, and more likely, due to leaving work altogether, then we find that couples are more likely to be in the first group, whereas one parent families NERs are more likely to fall into the second.[8]

Amongst couple NERs, 44% have a main earner on over £200, whereas amongst lone parent NERs only 11% fall into this group. Average earnings of the two groups of NERs are correspondingly sharply different - £175 for couple NERs, but just £75 for single parents. It seems that increased earnings are much more likely to result in the loss of entitlement for couples than for lone parents. One possible reason is that some couples in the data may have only recently partnered – a lone parent earning a small amount that left them qualifying for benefit a few months prior to the FRS interview could have recently partnered someone with comparatively high earnings, which leaves the family without FC entitlement on the basis of current circumstance. Obviously there is no comparable possibility for those appearing as lone parents in our data.

[7] See Section 3.4.2 and Appendix 2 for discussion of this method.

[8] There is panel-data evidence that lone parents are relatively more likely to leave family credit due to leaving employment, while couples who leave it are more likely to be 'floated' out of entitlement through increasing earnings. See Bryson, A. and Marsh, A. (1996), *Leaving Family Credit*, London: HMSO.

Lone parents, on the other hand, are far more likely to have become workless than couples. Over a third of NER lone parents are actually on zero hours, amongst couples the figure is less than half this – at 15%.

Number of children - The distribution of children is fairly similar across the two groups – ERs and NERs. Those with entitlement have slightly more children on average (2.0 rather than 1.9). The relative likelihood of having young or old children is not different between groups.

(c) Receipt

Average receipt for the two groups of recipients is very close - £54 for those with entitlement and £50 for those without. For those with entitlement the average amount of modelled receipt is very close to the average amount of modelled entitlement - £52.

The distribution is also broadly comparable as Table 3.14 shows. This is a very significant finding because one possible explanation for the existence of the NER group is that modelled entitlement is a measure which has some degree of error. But if this were very important, we would expect that the NER group would typically be people whose incomes were sufficient to leave them on only very low levels of FC, which some slight degree of random error – either in recorded income, or in the modelling process – would easily lead to zero modelled entitlement. In contrast, a degree of random error in TAXBEN's award of entitlement would be very unlikely to explain NERs on higher levels of entitlement. But the table shows that a significant fraction of NERs fall into the high-entitlement category, and this, combined with the similar average level of receipt found amongst ERs and NERs, makes it very unlikely that random error in modelled entitlement explains much of the receipt without entitlement that we have found.

Table 3.14. Distribution of receipt for those with and without entitlement

Receipt of FC	Receiving and entitled (%)	Receiving without entitlement (%)
<£30	18 %	25 %
£30 - £60	41 %	41 %
>£60	41 %	34 %
Total	100%	100%

3.4.4 Can panel data add anything to our knowledge?

We have used a combination of the FRS and model output to examine the characteristics of the NER group. But we have had to draw rather uncertain inferences from their income and hours data about why it is that they have lost current eligibility. Further, we have been implicitly assuming that we can explain 100% of the NER group by the dynamics of wages and hours in families, whereas it is possible that some membership of this group is better explained by other possibilities - administrative error, mistakes in model computer algorithms, fraud.

A good source of labour market panel data of FC recipients would enable us gauge the extent of wage and hours dynamics amongst recipients, which would make allow us to

see both whether it was reasonable to attribute membership of the NER group to such dynamics. In particular, we would be able to look at the labour market dynamics of the group moving off the benefit – which we would expect to be the people that we are classing as NER. Further, it would offer us further evidence on whether some of the findings suggested by the previous section – such as the high propensity for lone parents on FC to be on zero hours, the high propensity of couple NERs to be on high earnings, and the different wage distributions of NERs and ERs - were indeed caused by differential dynamics between groups. Panel data could also enable us to disentangle any evidence of strategic alteration of hours (with a view to maximising FC receipt) amongst benefit recipients from incidental changes in hours. Most importantly, better data on dynamics would improve the prospects of adjusting modelled results in the light of the NER group.

The ideal data for getting a handle on dynamics through the six month period would have information on FC receipt, earnings, hours and labour market status, and would re-interview the panel at short intervals (6 months or less). It would also have to contain sufficient numbers of families to leave us with sub-groups of FC recipients for us to be able to make statistically significant inferences about them. The Quarterly Labour Force Survey (QLFS) would in many ways make an ideal panel for our purposes. Each quarter a new panel of around 12,000 households is begun and followed for five consecutive quarters. The survey collects a large variety of labour market data, and also asks about FC receipt. But there is an insurmountable problem with the QLFS – only the fifth and final time that recipients are questioned are they asked about either their wage or their FC receipt. This means that attempting to analyse the dynamics of either wages or benefit receipt, or the interaction of the two, would not be possible using the QLFS – in spite of it being a panel survey, we only have data for the variables that we are most concerned with at one point in time.

A final possibility that we investigated was use of a panel survey of lone parents conducted by the DSS and the Policy Studies Institute as part of their Programme of Research Into Low Income Families (PRILIF). The PRILIF lone parent cohort survey initially collated detailed information on the earnings, working hours and benefit receipt of around 1,000 lone parents in July 1991. Fortuitously for our purposes, the initial survey deliberately over-sampled FC recipients. Data is also available on three full waves of re-interviews of the group, at roughly 18-month interviews. By the time of the fourth wave, in July 1995, there were 627 lone parents remaining – the rest had attritted – either ceasing to co-operate with the survey, or else being impossible to contact.[9]

One obvious difficulty in trying to learn anything about NERs from the PRILIF data is that the length of time between the observations is 18 months, whereas the maximum amount of time that the information used to derive FC entitlement can lag current circumstances is six months. We might expect that the result would be that the circumstances of FC recipients in the PRILIF data would change much more on average than the circumstances of the FRS FC recipients have changed since their last interview.

[9] Ongoing work by Gill Paul at the Institute for Fiscal Studies is constructing a continuous time-panel from PRILIF data.

But there is an offsetting concern, which applies to all panel data. People who have had stable circumstances are more likely to remain in the PRILIF survey across waves – principally because they are less likely to have moved. As a result when we compare over waves, which we can only do for those observations that do not attrit, we are looking at a sample whose circumstances may be atypically stable.

We focussed on making some comparisons with the FRS/TAXBEN results on lone parent NERs with the two most recent waves of the PRILIF panel – May 1994 and July 1995. We chose the most recent waves for which data is available to ensure that the data was not so old as to prevent direct comparability with the FRS. In terms of the numbers on benefit we found:

- 22% of the 627 in the panel in both waves were on FC in the May 1994; this compares with just 13.5% of lone parents in the 1996/97 FRS who are on FC. The difference reflects both the fact that the FRS under-samples FC recipients, and the fact that the initial PRILIF data deliberately over-represented them.

- The total number on FC in the PRILIF data is 138 in 1994 and 127 in 1995. Of the 138 who were on FC in 1994, 90 remained there in 1995 – so we have information on 48 people who moved off the benefit. Correspondingly, of the 127 on the benefit in 1995, 37 had moved onto it since the last interview.

So, for the group that we are most interested in from the point of view of exploring the dynamics underpinning the move off FC – people who left benefit between waves, who might be expected to have been NERs at some point – there are less than fifty observations. This makes sample size a concern – particularly because we would like to break this group down into sub-groups that move off the benefit for different reasons.

Looking at the labour market behaviour of all those on FC in 1994 over time revealed that:

- 130 of the 138 FC recipients in 1994 were doing more than 16 hours a week employment at the time of interview. Of this 130, 10 had ceased to be in this category by the time of the 1995 interview. This suggests that there is very little movement out of work amongst FC recipients. This contrasts with the picture suggested by the NER lone parents in the FRS, amongst whom it seemed a significant fraction had moved out of work. Around 20% of the lone parents in the FRS were working less than 16 hours a week at the time of interview, and this amounted to more than 60% of those in the NER category.

- For many of the 120 employees on FC in 1994 who continued to work more than 16 hours a week in 1995, pay was relatively stable - the median pay rise was just over £3 a week. But the top quartile of rises, 30 observations, has seen rises of £20.90 a week or more. Of these 30, 10 had ceased to be on FC – these are individuals who are likely to have been floated off FC by their pay increase.

It is striking that the numbers moving out of work seems so low compared to the FRS, particularly when it is considered that in PRILIF there has been 18 months during which circumstances could change between interviews, whereas there is only likely to be an average of a three month lag between the assessment of circumstances for FC and the

their recording in the FRS. This might be evidence for the differential attrition: perhaps those who have moved out of work are less likely to be available for re-interview, and so there are surprisingly few such individuals left in the PRILIF data.

Overall, the PRILIF data offers us only a little extra evidence about the changing labour market position of lone parents on FC over time. There are too many problems for the drawing of firm inferences which have direct applicability to the FRS – differential attrition, sample size, gaps between interviews which are excessively long to facilitate the study of dynamics for the time horizon in which we are interested.

3.4.5 Can we do anything to adjust for the group?

The ideal adjustment of tax and benefit model results for the NER group would have to be capable of both preserving the detail of the model's distributional results and of ensuring that the ability to model the effects of changing the parameters of the FC system was not lost. The adjustment to results that we carried out in the light of non-take up had just such properties. But achieving the same for NERs is more difficult: it would not simply have to deal with the probability of an individual falling into one state rather than another (e.g. taking up benefit, not taking up benefit), but also with the attributing to certain individuals of particular amounts of benefit which the model did not calculate as being their entitlement. The simplest solution might be to somehow use the recorded receipt of those without entitlement. But this would be to prevent modelling – if we assigned, for example, the £15 of FC that an NER lone parent reported as receiving in the data, then there would be no way of altering this by reforming the tax and benefit system. This type of adjustment, then, could never inform the distributional results of modelling reform.

The ideal way to adjust results would involve calculating statistical estimates of the probabilities of each family that is calculated as not being eligible for FC being on various configurations of hours and earnings over the previous six months. The derivation of such estimates, if they were to be robust, would require the use of high-quality panel data with large sample sizes, and with frequent interviews. The data for every family for each of the various earnings/hours combinations would then need to be fed through the tax and benefit model's FC routine, to calculate an array of possible levels of entitlement. The level of benefit calculated for each configuration would then be weighted by the probability of the family having been on the hours/earnings configuration that gave rise to the particular level of entitlement. This could be implemented through adjustment to grossing factors, so that each family effectively represented a range of different families with different employment and earnings paths, with the weight attached to each of these 'family histories' dependent on its probability of having being the actual history of the family in the data.

Unfortunately, our survey of the panel data available in Section 3.4.4 suggests that there is no panel survey available which even approaches the requirements that such an adjustment process would require. We therefore turn to consider the possibility of calibrating model output to known administrative totals in an attempt to obtain model results that have direct model application.

3.5 Calibrating results – the example of the WFTC reform package

After having adjusted the results for non-take up of benefit, TAXBEN's results for FC remain out of line with the data recorded by the government in its administrative statistics for two main reasons. First, the non-take-up correction process that we use means that, abstracting from other difficulties, we would expect to end up with modelled results that put the numbers in receipt of FC at about the level suggested by the input data. But we have established that the FRS under-represents FC recipients, under-representation that our 'corrected' results will mirror. Secondly, we have found no satisfactory way of correcting for the NER group – that is, people who are receiving the FC, but to whom the model does not award entitlement.

We now turn to consider how the corrected-for-take-up modelled results of a benefit reform can be corrected in the light of known administrative totals. In attempting to calibrate the results of modelled reform we first need to quantify the margin of error that the modelled results are exhibiting in the base system. But there are (at least) two different dimensions of error that might be relevant – first, cost, and secondly, the number of people being entitled. Once adjusted for take-up, TAXBEN's estimates for the cost of and the numbers on FC for 1996/97 compare with administrative totals as follows:

- TAXBEN results put the cost of FC at £1.247 billion – 67% of actual expenditure on FC in 1996/97 - £2.084 billion.

- Once allowance is made for non-take up, TAXBEN calculates that there are 444,000 families in receipt of the benefit, compared to the 725,000 found in administrative figures for November 1996. This means our results only suggest receipt at 61% of its true level.

We can use our knowledge of the degree of under-representation in our results to alter our projections for the effects of reform. There are two obvious ways to do this, which might have very different results. First changing the relativities in grossing factors, and secondly, simply increasing the weight of the entire population.

The first approach involves changing the relativities in the grossing factors in the results, so that we increase the weight of all those we model to be receiving FC by the amount needed to correct under-representation, while at the same time reducing the factors applied to all other families by the requisite amount to ensure that the data overall continued to be grossed up to the total number of families in the population. The problem with this approach comes when we turn to consider the modelling of a reform which makes FC more generous, and increasing the number of individuals that we model to be receiving it. The adjustment of relative weights to correct for the under-representation of FC in the results means that we would be reducing the weights of all people that do not receive FC under the base system – including those who would be 'floated into' entitlement by an increase in the system's generosity.

But there is reason to expect that the model will under-represent those who move into receipt as a result of reform, just as it under-represents in the base system. First, because those families who are currently just without entitlement (but who stand to acquire it as a result of reform) are likely to have very similar characteristics to those already with

entitlement – their circumstances are only marginally different from those amongst the group that currently have the lowest level of entitlement. And to the extent that it is characteristics of families on benefit, which are shared by those with income just above that needed for entitlement, rather than the fact that of benefit entitlement itself, that drives their under-representation, we would expect the families currently just outside the benefit system to be similarly under-represented. Secondly, just as reform increases the number of entitled recipients, so it will also increase the number of NERs – because the fact that eligibility becomes possible at higher income levels means that more people will have satisfied the requirements of eligibility in the last six months, even if they have since become ineligible on the basis of current circumstances.

For these reasons we reject this method of calibrating results in modelling reforms that increase the numbers entitled to means-tested benefits. It might be argued that it remains useful for modelling reform which cuts benefit expenditure and the numbers on benefit, but much could be inferred from administrative data on the effects of such reform, making it less likely that policy makers would need to rely on the use of tax and benefit models for analysis in such cases.

Instead we propose calibration by the second method – increasing the weights of all families in the population by the necessary number to leave the scale of the benefit estimated correctly. One effect of this method is that the results will imply an over-estimate of the total population. For minor reform this need does not matter - as long as we have reason to be confident that those brought into entitlement are equivalently under-represented to those already entitled. But if there were a really big increase in the generosity of a means tested benefit, that would lead to very different types of families being floated into entitlement from those who already enjoy it, there might be reason to be concerned about the proposed solution. For, trivially, it cannot be the case that all types of families were originally under-represented. If reform is bringing new types of families into entitlement, then it is likely that some of these would not have been under-represented in the pre-calibrated results. There must come a point – once the increase in the numbers of people floated into entitlement by reform is very great – when this mode of calibration would lead to an over-weighting of those who are floated into entitlement. Nonetheless, for reforms that do not radically change the average characteristics of entitled group, we judge this the best procedure.

We can now look at how the process of 'calibrating' results that we are discussing works in a specific case – that of the package of reforms to the FC system that precedes its replacement by the WFTC. The Chancellor announced these changes in his March 1998 budget. They will come into force in October 1999. It was announced that the generosity of the FC system would increase in three ways (ignoring the new childcare credit, which we do not model here). First, a £2.50 increase in the child credit for under 11 year olds, second, a 15% cut in the taper (taking it to 55%), and, finally, an increase in the applicable amount to £90. We have modelled the introduction of the reform on the 1996/97 data set using the 1996/97 system as our base (This necessitated deflating the increase in the applicable amount and the child credit to 1996/97 prices). We find that, once we have adjusted for take up in both the base and the reformed system, TAXBEN's results suggest:

- Expenditure on FC rising from £1.247 billion to £1.844 billion, an increase of £594 million, or 48%.

- The numbers of families on benefit is seen to increase from 444,000 to 641,000 an increase of 197,000, or 44%.

We have argued that there is reason to think that both numbers will be underestimated, in just the same way that TAXBEN underestimates the numbers on and cost of FC in the base system. [10] So, we next adjust the results by dividing the grossing factors of all families – both pre- and post-reform - by the fraction necessary to ensure that TAXBEN correctly models the scale of FC in the base system. But this fraction varies depending upon whether we want TAXBEN's results to be forced to agree on expenditure or numbers on in the base system. If the aim is to get expenditure right then the increase should be divided by 0.67 (corresponding to the 67% of actual expenditure that TAXBEN's base system calculation of FC expenditure represents). If the aim is to get the numbers entitled right then the increase should be divided by 0.61 (corresponding to the 61% of numbers receiving that TAXBEN's base system calculation of FC expenditure represents). Table 3.16 shows the effects of calibrating in each of the two ways on the estimated effects of the reform.

Table 3.16. Different estimates of cost of the WFTC package of reforms.

	Non-calibrated	Calibrated to get base system numbers receiving right	Calibrated to get base system expenditure right
Cost of increase	£ 594 million	£ 974 million	£ 887 million
Numbers 'floated on' (000s)	197	323	294

Calibration to ensure that numbers receiving benefit is correctly calculated under the base system leads to estimates that are 10% bigger than results based on calibrating expenditure, both for the increase in expenditure and numbers receiving. In this case, the difference between the two sets of estimates for the impact of change are within the margins of error that we would normally attach to model output. The relatively high degree of agreement between the two sets of estimates reflects the relatively similar distributions of entitlement found in the adjusted results and in administrative data (a similarity which itself reflects the accurate distribution of entitlement in the 1996/97 FRS).

But where the distribution of modelled receipt in the base system is very different from that in the administrative data, the two sets of calibrated estimates for the effects of reform will be further apart from one another. If, for example, the take-up-adjusted modelled results showed far more people with very low levels of benefit entitlement than were seen in the administrative data, the resulting low average level of FC entitlement in the model's output would mean that calibrating results to ensure that the model correctly

[10] This argument is assuming that those 'floated on' to benefit by the WFTC package have sufficiently similar characteristics to those already in receipt of FC to make it likely that they will be similarly under-represented in the model's output.

calculated expenditure on benefit in the base system correctly would necessitate a much bigger adjustment than calibration to the correct numbers of recipients. In these circumstances, we should be cautious about assuming that either method of calibration will give us an approximation to the 'correct' result. For the implication of the model's results (adjusted for take-up) misrepresenting the distribution of entitlement is that FC recipients in different financial circumstances (who consequently have different levels of entitlement) are differentially misrepresented in the results. And in this case we can not assume that the families 'floated onto' benefit by reform will be under-represented by the same factor as existing FC recipients are on average. This could be deemed to render any system of uniform re-weighting inappropriate.

4. Conclusions

The two surveys used by TAXBEN, the FES and the FRS, both consistently under-represent the numbers of people on FC relative to administrative data and this under-representation is aggravated by the grossing schemes normally applied to the data. This will be a worry if one wants to ensure accurate modelling of the numbers of people entitled to, and the cost of a benefit. If the surveys do not contain enough of the type of people who get FC, then abstracting from all other problems we would expect the model that runs on it to under-represent the numbers entitled.

In spite of systematic under-representation the input data is generally quite representative in the composition of its FC recipient sample. On average, couples and lone parents are under-represented to the same extent, meaning that the overall balance between the two is reasonably well maintained. Likewise, the distribution of entitlements, the make up of the sample by family size, and the balance between employees and the self employed is all satisfactory when looked at in both the FRS and the FES over a number of years. There is more divergence with official figures in the distribution of earnings. The mean in the survey consistently exceeds that recorded by the government due to the larger numbers of families – especially couples – reporting high incomes in the FRS. But at the same time there are a number of recipients reporting zero earnings in FRS, whereas there are none in official figures. This leaves the mean masking the true extent to which reported earnings in the FRS exceed the official figures.

There is substantial mismatch between those reporting receipt of FC and those that TAXBEN models as entitled. Despite the fact that the FES and FRS both under-represent FC recipients, the raw modelled results show substantially more people to be entitled to FC than are actually recorded as receiving the benefit in the administrative statistics. There are two major groups which cause concern here – first, those with modelled entitlement but not receiving in the data and, secondly, those receiving in the data but with no modelled entitlement. For the first group, we estimate probit regressions to control for the likelihood of take-up conditional on the family characteristics and the level of modelled entitlement. This correction yields a distribution of modelled entitlement that better matches the distribution of payments found in the administrative data. The self-employed constitute a significant portion of the entitled non-recipient group, and we have improved the match of our adjusted results to administrative totals by excluding them from our take-up regressions. The rationale for and difficulties with this exclusion are considered further in Appendix 2.

For the second group, non-entitled recipients, we examine the available panel data sources for evidence on the dynamic processes that may have altered the families' circumstances between claiming FC and being interviewed in the survey. While this produces some interesting results, the available data does not allow us to develop any new means of dealing with these families in simulation modelling.

We conclude by examining various means of calibrating the modelled results to match administrative statistics. This may be seen as an ad-hoc adjustment. But there currently appears to be little alternative if we wish to address, first, the problem of under-representation of FC recipients in the initial data and, second, the problem of changing

circumstances between the point at which benefit is claimed and the interview date. In the longer term, the first of these problems may be resolved by further investigation of the grossing schemes used by both the FES and the FRS. To solve the second problem, we need a greater understanding of the dynamics that affect the claimant group. However, it should be noted that while the currently available evidence from panel data cannot be used to directly answer the main points under examination, it does suggest that the dynamic forces are not large enough to explain all the differences between the recipient data and the modelled results.

Appendix 1: Detailed comparisons between administrative data and FRS and FES data

Table A1.1 The 1994/95 Family Resources Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '94/95 administrative count	Fraction of FRS recipients
All families	< £30	26%	26%
	£30 - £60	40%	43%
	> £60	35%	31%
	Total	100%	100%
		(Total number 579,000)	(Total number 419,000, 72% of official count)
Lone Parents	< £30	18%	17%
	£30 - £60	46%	48%
	> £60	36%	35%
	Total	100%	100%
		(Total number 250,000)	(Total number 178,000, 71% of official count)
Couples	< £30	31%	32%
	£30 - £60	34%	40%
	> £60	34%	29%
	Total	100%	100%
		(Total number 328,000)	(Total number 237,000, 72% of official count)
Families with one child	< £30	30%	25%
	£30 - £60	57%	61%
	> £60	13%	13%
	Total	100%	100%
		(Total number 211,000)	(Total number 153,000, 73% of official count)
Families with two children	< £30	26%	26%
	£30 - £60	32%	34%
	> £60	43%	40%
	Total	100%	100%
		(Total number 211,000)	(Total number 158,000, 75% of official count)
Families with three or more children	< £30	19%	25%
	£30 - £60	27%	31%
	> £60	54%	44%
	Total	100%	100%
		(Total number 160,000)	(Total number 103,000, 64% of official count)

Table A1.2 The 1995/96 Family Resources Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '95/96 administrative count	Fraction of FRS recipients
All families	< £30	18%	25%
	£30 - £60	40%	38%
	> £60	41%	37%
	Total	100%	100%
		(Total number 648,000)	(Total number 506,000, 78% of official count)
Lone Parents	< £30	13%	19%
	£30 - £60	47%	49%
	> £60	41%	32%
	Total	100%	100%
		(Total number 291,000)	(Total number 241,000, 83% of official count)
Couples	< £30	23%	31%
	£30 - £60	35%	28%
	> £60	42%	41%
	Total	100%	100%
		(Total number 358,000)	(Total number 264,000, 74% of official count)
Families with one child	< £30	22%	30%
	£30 - £60	59%	55%
	> £60	19%	15%
	Total	100%	100%
		(Total number 243,000)	(Total number 213,000, 88% of official count)
Families with two children	< £30	19%	27%
	£30 - £60	33%	29%
	> £60	48%	44%
	Total	100%	100%
		(Total number 235,000)	(Total number 180,000, 77% of official count)
Families with three or more children	< £30	12%	15%
	£30 - £60	25%	19%
	> £60	64%	66%
	Total	100%	100%
		(Total number 170,000)	(Total number 113,000, 66% of official count)

Table A1.3 The 1996/97 Family Resources Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '96/97 administrative count	Fraction of FRS recipients
All families	< £30	18%	18%
	£30 - £60	38%	38%
	> £60	44%	44%
	Total	100%	100%
		(Total number 725,000)	(Total number 532,000, 73% of official count)
Lone Parents	< £30	12%	13%
	£30 - £60	44%	40%
	> £60	44%	47%
	Total	100%	100%
		(Total number 329,000)	(Total number 228,000, 69% of official count)
Couples	< £30	23%	22%
	£30 - £60	33%	37%
	> £60	44%	41%
	Total	100%	100%
		(Total number 396,000)	(Total number 304,000, 77% of official count)
Families with one child	< £30	21%	21%
	£30 - £60	57%	52%
	> £60	22%	27%
	Total	100%	100%
		(Total number 271,000)	(Total number 186,000, 68% of official count)
Families with two children	< £30	19%	19%
	£30 - £60	30%	35%
	> £60	52%	45%
	Total	100%	100%
		(Total number 262,000)	(Total number 208,000, 80% of official count)
Families with three or more children	< £30	12%	12%
	£30 - £60	23%	24%
	> £60	65%	64%
	Total	100%	100%
		(Total number 192,000)	(Total number 138,000, 72% of official count)

Table A1.4 The 1994/95 Family Expenditure Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '94/95 administrative count	Fraction of FES recipients
All families	< £30	26%	22%
	£30 - £60	40%	50%
	> £60	35%	28%
	Total	100%	100%
		(Total number 579,000)	(Total number 461,000, 80% of official count)
Lone Parents	< £30	18%	13%
	£30 - £60	46%	56%
	> £60	36%	30%
	Total	100%	100%
		(Total number 250,000)	(Total number 243,000, 97% of official count)
Couples	< £30	31%	34%
	£30 - £60	34%	42%
	> £60	34%	25%
	Total	100%	100%
		(Total number 328,000)	(Total number 211,000, 64% of official count)
Families with one child	< £30	30%	21%
	£30 - £60	57%	70%
	> £60	13%	9%
	Total	100%	100%
		(Total number 211,000)	(Total number 153,000, 88% of official count)
Families with two children	< £30	26%	18%
	£30 - £60	32%	36%
	> £60	43%	45%
	Total	100%	100%
		(Total number 211,000)	(Total number 176,000, 83% of official count)
Families with three or more children	< £30	19%	34%
	£30 - £60	27%	33%
	> £60	54%	32%
	Total	100%	100%
		(Total number 160,000)	(Total number 93,000, 58% of official count)

Table A1.5 The 1995/96 Family Expenditure Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '95/96 administrative count	Fraction of FES recipients
All families	< £30	18%	22%
	£30 - £60	40%	42%
	> £60	41%	36%
	Total	100%	100%
		(Total number 648,000)	(Total number 460,000, 71% of official count)
Lone Parents	< £30	13%	19%
	£30 - £60	47%	52%
	> £60	41%	29%
	Total	100%	100%
		(Total number 291,000)	(Total number 192,000, 66% of official count)
Couples	< £30	23%	24%
	£30 - £60	35%	36%
	> £60	42%	40%
	Total	100%	100%
		(Total number 358,000)	(Total number 259,000, 72% of official count)
Families with one child	< £30	22%	37%
	£30 - £60	59%	48%
	> £60	19%	15%
	Total	100%	100%
		(Total number 243,000)	(Total number 164,000, 67% of official count)
Families with two children	< £30	19%	20%
	£30 - £60	33%	37%
	> £60	48%	43%
	Total	100%	100%
		(Total number 235,000)	(Total number 158,000, 67% of official count)
Families with three or more children	< £30	12%	7%
	£30 - £60	25%	42%
	> £60	64%	51%
	Total	100%	100%
		(Total number 170,000)	(Total number 128,000, 75% of official count)

Table A1.6 The 1996/97 Family Expenditure Survey – Distribution of receipt across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '96/97 administrative count	Fraction of FES recipients
All families	< £30	18%	18%
	£30 - £60	38%	42%
	> £60	44%	40%
	Total	100%	100%
		(Total number 725,000)	(Total number 614,000, 85% of official count)
Lone Parents	< £30	12%	12%
	£30 - £60	44%	48%
	> £60	44%	40%
	Total	100%	100%
		(Total number 329,000)	(Total number 260,000, 79% of official count)
Couples	< £30	23%	23%
	£30 - £60	33%	38%
	> £60	44%	39%
	Total	100%	100%
		(Total number 396,000)	(Total number 340,000, 86% of official count)
Families with one child	< £30	21%	19%
	£30 - £60	57%	61%
	> £60	22%	20%
	Total	100%	100%
		(Total number 271,000)	(Total number 259,000, 95% of official count)
Families with two children	< £30	19%	21%
	£30 - £60	30%	29%
	> £60	52%	51%
	Total	100%	100%
		(Total number 262,000)	(Total number 168,000, 64% of official count)
Families with three or more children	< £30	12%	14%
	£30 - £60	23%	28%
	> £60	65%	58%
	Total	100%	100%
		(Total number 192,000)	(Total number 175,000, 91% of official count)

Table A1.7 1994/95 Family Resources Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Oct '94	Fraction of recipients in FRS
All	< £40	6%	12%
	£40 - £80	32%	29%
	£80 – £120	23%	18%
	£120 - £160	20%	17%
	> £160	19%	24%
	Total	100%	100%
		(Total number 578,000)	(Total number 419,000)
Single parents	< £40	5%	13%
	£40 - £80	42%	39%
	£80 – £120	27%	21%
	£120 - £160	16%	16%
	> £160	10%	11%
	Total	100%	100%
		(Total number 249,000)	(Total number 177,000)
Couples	< £40	7%	11%
	£40 - £80	25%	21%
	£80 – £120	20%	16%
	£120 - £160	22%	18%
	> £160	26%	34%
	Total	100%	100%
		(Total number 329,000)	(Total number 237,000)

Table A1.8 TAXBEN run on 1994/95 Family Resources Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '94/95 administrative count	Fraction of modelled entitlements
All families	< £30	26%	42%
	£30 - £60	40%	33%
	> £60	35%	24%
	Total	100%	100%
		(Total number 579,000)	(Total number 687,000, 119% of official count)
Lone Parents	< £30	18%	34%
	£30 - £60	46%	38%
	> £60	36%	28%
	Total	100%	100%
		(Total number 250,000)	(Total number 227,000, 91% of official count)
Couples	< £30	31%	46%
	£30 - £60	34%	31%
	> £60	34%	23%
	Total	100%	100%
		(Total number 328,000)	(Total number 461,000, 141% of official count)

Table A1.9 1995/96 Family Resources Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Oct '95	Fraction of recipients in FRS
All	< £40	6%	11%
	£40 - £80	32%	29%
	£80 – £120	23%	18%
	£120 - £160	18%	16%
	> £160	21%	26%
	Total	100%	100%
		(Total number 643,000)	(Total number 508,000)
Single parents	< £40	5%	12%
	£40 - £80	40%	36%
	£80 – £120	27%	20%
	£120 - £160	16%	17%
	> £160	12%	16%
	Total	100%	100%
		(Total number 287,000)	(Total number 242,000)
Couples	< £40	7%	11%
	£40 - £80	26%	23%
	£80 – £120	19%	16%
	£120 - £160	20%	16%
	> £160	28%	35%
	Total	100%	100%
		(Total number 356,000)	(Total number 264,000)

Table A1.10 TAXBEN run on 1995/96 Family Resources Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '95/96 administrative count	Fraction of modelled entitlements
All families	< £30	18%	35%
	£30 - £60	40%	32%
	> £60	41%	33%
	Total	100%	100%
		(Total number 648,000)	(Total number 843,000, 130% of official count)
Lone Parents	< £30	13%	28%
	£30 - £60	47%	40%
	> £60	41%	32%
	Total	100%	100%
		(Total number 291,000)	(Total number 289,000, 99% of official count)
Couples	< £30	23%	39%
	£30 - £60	35%	28%
	> £60	42%	33%
	Total	100%	100%
		(Total number 358,000)	(Total number 554,000, 155% of official count)

Table A1.11 1996/97 Family Resources Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Nov '96	Fraction of FRS recipients
All	< £40	5%	9%
	£40 - £80	32%	24%
	£80 – £120	22%	18%
	£120 - £160	17%	18%
	£160 - £200	14%	14%
	> £200	10%	16%
	Total	100%	100%
		(Total number 725,000)	(Total number 532,000)
Single parents	< £40	4%	15%
	£40 - £80	40%	33%
	£80 – £120	26%	21%
	£120 - £160	15%	17%
	£160 - £200	9%	9%
	> £200	5%	5%
	Total	100%	100%
		(Total number 329,000)	(Total number 227,000)
Couples	< £40	7%	6%
	£40 - £80	25%	17%
	£80 – £120	18%	16%
	£120 - £160	18%	18%
	£160 - £200	17%	18%
	> £200	14%	24%
	Total	100%	100%
		(Total number 396,000)	(Total number 304,000)

Table A1.12 TAXBEN run on 1996/97 Family Resources Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '96/97 administrative count	Fraction of modelled entitlements
All families	< £30	18%	35%
	£30 - £60	38%	34%
	> £60	44%	31%
	Total	100%	100%
		(Total number 725,000)	(Total number 815,000, 112% of official count)
Lone Parents	< £30	12%	24%
	£30 - £60	44%	38%
	> £60	44%	38%
	Total	100%	100%
		(Total number 329,000)	(Total number 260,000, 79% of official count)
Couples	< £30	23%	40%
	£30 - £60	33%	32%
	> £60	44%	28%
	Total	100%	100%
		(Total number 396,000)	(Total number 553,000, 140% of official count)

Table A1.13 1994/95 Family Expenditure Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Oct '94	Fraction of recipients in FES
All	< £40	6%	6%
	£40 - £80	32%	29%
	£80 – £120	23%	20%
	£120 - £160	20%	22%
	> £160	19%	23%
	Total	100%	100%
		(Total number 578,000)	(Total number 463,000)
Single parents	< £40	5%	7%
	£40 - £80	42%	40%
	£80 – £120	27%	25%
	£120 - £160	16%	17%
	> £160	10%	11%
	Total	100%	100%
		(Total number 249,000)	(Total number 243,000)
Couples	< £40	7%	6%
	£40 - £80	25%	16%
	£80 – £120	20%	15%
	£120 - £160	22%	25%
	> £160	26%	38%
	Total	100%	100%
		(Total number 329,000)	(Total number 212,000)

Table A1.14 TAXBEN run on 1994/95 Family Expenditure Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '94/95 administrative count	Fraction of modelled entitlements
All families	< £30	26%	37%
	£30 - £60	40%	38%
	> £60	35%	24%
	Total	100%	100%
		(Total number 579,000)	(Total number 735,000, 127% of official count)
Lone Parents	< £30	18%	26%
	£30 - £60	46%	49%
	> £60	36%	25%
	Total	100%	100%
		(Total number 250,000)	(Total number 307,000, 123% of official count)
Couples	< £30	31%	45%
	£30 - £60	34%	31%
	> £60	34%	24%
	Total	100%	100%
		(Total number 328,000)	(Total number 430,000, 131% of official count)

Table A1.15 1995/96 Family Expenditure Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Oct '95	Fraction in FES
All	< £40	6%	9%
	£40 - £80	32%	16%
	£80 – £120	23%	17%
	£120 - £160	18%	22%
	> £160	21%	36%
	Total	100%	100%
		(Total number 643,000)	(Total number 460,000)
Single parents	< £40	5%	8%
	£40 - £80	40%	24%
	£80 – £120	27%	31%
	£120 - £160	16%	18%
	> £160	12%	19%
	Total	100%	100%
		(Total number 287,000)	(Total number 191,000)
Couples	< £40	7%	10%
	£40 - £80	26%	9%
	£80 – £120	19%	7%
	£120 - £160	20%	23%
	> £160	28%	50%
	Total	100%	100%
		(Total number 356,000)	(Total number 259,000)

Table A1.16 TAXBEN run on 1995/96 Family Expenditure Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '95/96 administrative count	Fraction of modelled entitlements
All families	< £30	18%	37%
	£30 - £60	40%	33%
	> £60	41%	30%
	Total	100%	100%
		(Total number 648,000)	(Total number 813,000, 125% of official count)
Lone Parents	< £30	13%	38%
	£30 - £60	47%	42%
	> £60	41%	20%
	Total	100%	100%
		(Total number 291,000)	(Total number 259,000, 89% of official count)
Couples	< £30	23%	36%
	£30 - £60	35%	29%
	> £60	42%	35%
	Total	100%	100%
		(Total number 358,000)	(Total number 554,000, 155% of official count)

Table A1.17 1996/97 Family Expenditure Survey – Distribution of earnings of main earners amongst FC recipients

Type of family	Weekly earnings of main earner	Fraction of official count – Nov '96	Fraction of recipients in FES
All	< £40	5%	5%
	£40 - £80	32%	30%
	£80 – £120	22%	20%
	£120 - £160	17%	14%
	£160 - £200	14%	12%
	> £200	10%	19%
	Total	100%	100%
		(Total number 725,000)	(Total number 613,000)
Single parents	< £40	4%	7%
	£40 - £80	40%	43%
	£80 – £120	26%	20%
	£120 - £160	15%	13%
	£160 - £200	9%	7%
	> £200	5%	9%
	Total	100%	100%
		(Total number 329,000)	(Total number 260,000)
Couples	< £40	7%	3%
	£40 - £80	25%	19%
	£80 – £120	18%	19%
	£120 - £160	18%	16%
	£160 - £200	17%	16%
	> £200	14%	28%
	Total	100%	100%
		(Total number 396,000)	(Total number 340,000)

Table A1.18 TAXBEN run on 1996/97 Family Expenditure Survey – Distribution of entitlements across different groups of families

Families Considered	Weekly amount of receipt	Fraction of '96/97 administrative count	Fraction of modelled entitlements
All families	< £30	18%	37%
	£30 - £60	38%	31%
	> £60	44%	32%
	Total	100%	100%
		(Total number 725,000)	(Total number 859,000, 118% of official count)
Lone Parents	< £30	12%	23%
	£30 - £60	44%	38%
	> £60	44%	38%
	Total	100%	100%
		(Total number 329,000)	(Total number 294,000, 89% of official count)
Couples	< £30	23%	43%
	£30 - £60	33%	27%
	> £60	44%	30%
	Total	100%	100%
		(Total number 396,000)	(Total number 565,000, 143% of official count)

Appendix 2: Using tax and benefit models to assess non-take-up of Family Credit

Our basic 'take-up' rate figure seems very low. It suggests that only 48% of people with entitlement are claiming. This is inconsistent with the DSS take-up figures based on the same data, which suggest that take-up of FC is 72% by caseload[11]. But the DSS figure has a very different derivation from ours. In this section we consider how one should go about estimating take-up figures from a tax and benefit model. We look at each of the differences between the DSS take-up figure and the crude figure that we obtained from the TAXBEN and the FRS data, and we will consider the merits of each of these adjustments, and how they might be incorporated into interpreting tax and benefit model output.

We will use the following abbreviation in this appendix –

R – total number of recipients; E – total number of families entitled; ER – number of families entitled and reporting receipt; ENR – number of families entitled and not receiving; NER – number of families without apparent entitlement but receiving.

A2.1 Inclusion of receipt where there is no eligibility

The basic take up figure from FRS of 48% is simply the following fraction:

$$\text{Take up rate} = ER/E$$

We count the number of ERs by using a combination of receipt recorded in the FRS and modelled eligibility – only those families with both receipt and modelled entitlement are included. In contrast, DSS use as their denominator the total number of recipients – not just those who are modelled as eligible. The implicit assumption is that no one is receiving illegitimately. This is not as extreme an assumption as it may seem – it does not assume there are no NERs, as even if no-one were receiving illegitimately, there may still be some NERs, owing to mistakes in modelling algorithms or due to the potential six-month lag between changing circumstances and the loss of FC entitlement. If we were to attempt to use this measure of take-up from FRS data and model output alone, we would have to work it out as:

$$\text{Take-up rate} = (ER + NER)/(E + NER) = R/(E + NER)$$

We have to include NERs in the denominator as well as the numerator to ensure that a take-up rate of above 100% is impossible. This alteration in the definition of take-up rate increases our basic figure of take-up to 56%.

One implication of using this measure of take-up is that take-up will appear to be increasing where fraud increases. But if fraud is small in scale relative to legitimate receipt without apparent entitlement (which could be due to data problems, mistakes in modelling algorithms or the lag between changing circumstances and the loss of FC

[11] Income Related Benefits: Estimates of Take-Up in 1996/7, DSS Analytical Services Division, Corporate Document Services, Leeds.

entitlement), then this feature of this method of measuring take-up may not be judged too problematic. In these circumstances, this adjusted measure is a better gauge of take-up than the crude ER/E figure.

Although it can be argued that this method of measuring take-up makes for the best method of estimation of the extent of the take-up problem, it cannot be readily applied to tax and benefit model results more generally. The difficulties presented by incorporating receipt by the non-entitled into modelled results are discussed in Section 3.4.

A2.2 Use administrative data for count of entitled recipients

The second major difference between our basic take-up figure and that produced by the DSS is that they take their count of those with receipt from official figures, rather than from the FRS. If the FRS is representative in terms of the number of FC recipients that it contains, this should not make any difference. But, as we saw in Section 2, the FRS systematically under-samples the recipients of this benefit, which means that using the administrative measure of receipt will boost the numbers receiving. This is seen most clearly by expressing the last equation as:

$$\text{Take-up rate} = R/(R + ENR)$$

Increasing R, by using administrative data instead of the FRS, increases both the numerator and the denominator, but as the denominator is greater the proportional effect on the numerator is greater, boosting the percentage. Using the administrative count of recipients boosts our take-up figure to 63%.

Whether administrative data should be used in calculating take-up figures is questionable. It guarantees that the total number of recipients will be correct, but nonetheless it is possible that it could leave the take-up rate less accurate. Consider, for example, that the under-sampling of FC recipients in the FRS could be accounted for by some feature (or collection of features) of the group that they shared with ENRs. In this case, we would expect ENRs to be as equally under-represented as Rs. Consequently, imposing the correct R while taking the number of ENRs from a combination of the FRS and model output would lead to an over-estimate of the take-up rate, where a measure of take-up that took both numbers from the model and the FRS would get the take-up rate right.

Even if we favoured the use of administrative data in estimating take-up rates, it would not be possible to incorporate it into our non-take-up adjustments of modelled results. This is because the regression techniques that we are employing to estimate the determinants of take-up demand that we have both modelled entitlement and recorded receipt on the one sample of families, and, of course, administrative data gives us no information on the receipt or otherwise of those houses in the FRS or FES that we model as being entitled to benefit.

A2.3 Exclusion of the self employed

Official figures on take-up exclude the self-employed entirely, on the grounds that the income data we have on them is too unreliable to form a reasonable basis on which to

model means-tested benefits. One important reason is that the income data collected on the self-employed in surveys like the FES and FRS is often very outdated, because questions are ask for financial details on the last period for which full business accounts are prepared. Previous IFS research on take-up has taken the same approach, and excluded the self-employed from consideration entirely.[12] Excluding the self-employed leaves our take-up rate at 70%.

Whether or not this exclusion is deemed desirable depends both on how poor income data on the self-employed is deemed to be, and also on how nervous one is about making the assumption that the take-up behaviour of the self-employed is identical to that of others. If the income data on the self employed is deemed good enough for a rough estimate of entitlement to FC, and if there is any reason to think that the self employed may differ systematically from employees in their propensity to take-up benefit, then including the self employed will be better. Otherwise, the approach of the DSS is probably best. In Section 3.3 of this report, which deals with adjusting modelled results for non take-up, we follow DSS (and earlier IFS) methodology in excluding the self-employed from our estimates of the determinants of take-up behaviour.

A2.4 Adjustment for 'lag' cases

In the same way that the six-month rule means that there are legitimate recipients of FC whose current income and hours means that we would model them without entitlement, so there must also be ENRs who would lack modelled entitlement because it is calculated on the basis of the 'snapshot' data in the FRS. For example, imagine a low-wage lone parent at a particular point in time working 25 hours a week which leaves her eligible for the benefit, but she fails to take up her entitlement, making her an ENR. She remains an ENR for six months even when she cuts her hours to 15 – which makes her ineligible on the basis of current circumstance – because it remains the case that if she had claimed the benefit in the first period, she would still be entitled in the second. How should take up figures be adjusted to allow for this group of 'invisible' ENRs?

DSS assume that the percentage of ENRs who are currently entitled is the same as the fraction of the total number of recipients that is currently entitled. The fraction of recipients that are entitled on the basis of current circumstance is estimated using the fraction of FC recipients who succeed in renewing their benefit entitlement at each six-monthly assessment – the renewal rate. This figure represents the fraction of FC recipients who are still entitled to the benefit six months after the initial claim. 100% of recipients are assumed to be entitled at the very beginning of their claim. This 100% is added to the renewal rate and divided by two to give the estimate of the fraction of recipients who are entitled on the basis of current circumstance at any one time. An implicit assumption is that there are no cases of people who are eligible at the point of the initial assessment, and who temporarily become ineligible (owing to job loss, or changing hours), before a second change in circumstance leaves them eligible again before the second assessment is due. If there are significant numbers of such people,

[12] Fry, V. & Stark, G., *The take-up of means-tested benefits, 1984-90* (1993), Institute for Fiscal Studies, London

then the estimate of the fraction of recipients entitled on the basis of current circumstance will be too high.

Having calculated the percentage of recipients with entitlement based on current circumstance, the assumption is made that the same fraction applies to ENRs. The ENR figure is then divided by this percentage to inflate it up to give the total number of ENRs. This inflated ENR figure is then used in the take-up calculation, which depresses the take-up figure. Increasing the count of ENRs in this way depresses our take-up figure by 4%, taking it to 66%[13].

In our adjustment of modelled results for non-take up we ignore the possibility of receipt without entitlement, principally because we go on to consider this problem separately in Section 3.4.

[13] This figure still differs from that produced by DSS for a number of reasons. Their figures are arrived using different computer algorithms from us that inevitably will lead to some differences. Further, they are using a different gross income measure from that used by TAXBEN, which as we saw in Section 3.3 can produce minor differences in results. Finally, they make further detailed adjustments that we do not consider here, such as the removal of individuals whose claims are being processed from the count of entitled non-recipients.

Appendix 3: Statistical results of probit regressions used to correct modelled results for no take up

Table A3.1 Lone Parents

Characteristic	Coefficient	Standard Error
Age	-0.114	0.955
Age-squared	0.001	0.013
Is social renter	0.386	0.191
Is private renter	-0.323	0.279
Amount of modelled entitlement	0.143	0.004
Has child under school-age	0.050	0.152
Number of children	0.140	0.478
Non-labour income of family	-0.003	0.004
Income of non-family members in household	-0.002	0.001
Lives in North	0.002	0.377
Lives in Yorks & Humber	0.215	0.388
Lives in North West	0.226	0.314
Lives in East Midlands	-0.355	0.358
Lives in West Midlands	0.075	0.340
Lives in London	-0.614	0.374
Lives in South East	-0.147	0.306
Lives in South West	0.259	0.418
Lives in Wales	0.435	0.499
Left education aged 16 - 18	0.051	0.216
Left education aged over 18	-0.372	0.447

The base region is Scotland; the base education group left school at 16 or under, and the base tenure group is owner-occupiers.

Table A3.2 Couples

Characteristic	Coefficient	Standard Error
Man's age	0.477	0.070
Man's age squared	-0.001	0.001
Woman's age	0.002	0.812
Woman's age squared	-0.000	0.001
Main earner is female	-0.286	0.169
Is social renter	0.340	0.152
Is private renter	0.080	0.249
Amount of modelled entitlement	0.016	0.003
Has child under school-age	0.050	0.172
Number of children	0.001	0.082
Non-labour income of family	-0.006	0.004
Income of non-family members in household	-0.000	0.001
Lives in North	0.181	0.307
Lives in Yorks & Humber	-0.253	0.279
Lives in North West	0.122	0.287
Lives in East Midlands	-0.116	0.273
Lives in West Midlands	-0.382	0.269
Lives in London	-0.509	0.287
Lives in South East	-0.250	0.246
Lives in South West	0.217	0.291
Lives in Wales	0.134	0.304
Family head left education aged 16 - 18	-0.162	0.200
Family head left education aged over 18	-0.297	0.318

The base region is Scotland; the base education group left school at 16 or under, and the base tenure group is owner-occupiers.

Appendix 4 – DSS Grossing Scheme for the FRS

The scheme grosses in four dimensions – family type, Council Tax band, region and tenure. The weights apply to every individual in the household. The groups are as follows:

Family type:

- Male one parent family
- Female one parent family
- Couple with kids
- Young couple without kids (head's age<65)
- Old couple without kids (head's age > 65)
- Young single male (age <35)
- Middle-age single male (35<age<60)
- Old single male (age>60)
- Young single female (age <35)
- Middle-age single female (35<age<60)
- Old single female (age>60)

Council Tax band:

- A and not classified
- B
- C and D
- E to H

Region:

- In London
- Not in London

Tenure:

- Local authority rented
- Private rented
- Owner Occupied